1 Introduction

1.1 Terms of Reference

2020/2/FRSG13 The Working Group Elasmobranch Fishes (WGEF), chaired by Jurgen Batsleer (Netherlands) and Pascal Lorance (France), will meet online from 15–24 June 2021 to:

a) Address generic ToRs for Regional and Species Working Groups.
b) Update the description of elasmobranch fisheries for deep-water, pelagic and demersal species in the ICES area and compile landings, effort and discard statistics by ICES Subarea and Division, and catch data by NEAFC Regulatory Area. Describe and prepare a first Advice draft of any emerging elasmobranch fishery with the available data on catch/landings, fishing effort and discard statistics at the finest spatial resolution possible in the NEAFC RA and ICES area(s);
c) Evaluate the stock status for the provision of biennial advice due in 2021 for: (i) skate stocks in the North Sea ecoregion, the Azores and MAR; (ii) catsharks (*Scyliorhinidae*) in the Greater North Sea, Celtic Seas and Bay of Biscay and Iberian Coast ecoregions; (iii) smooth-hounds in the Northeast Atlantic; and (iv) tope in the Northeast Atlantic
d) Conduct exploratory analyses and collate relevant data in preparation for the evaluation of other stocks (Porbeagle in the NE Atlantic; and skates in the Celtic Seas and Bay of Biscay and Iberian Coast ecoregions) in preparation for more detailed biennial assessment in 2022;
e) Follow the outcomes of WKSKATE and to make the best use of survey indices in the assessments where appropriate.
f) Take note of the outcome of the proposed stand-alone expert meeting dealing with the issue of missing data in the Portuguese surveys and the solutions suggested.
g) Collate discard data from countries and fleets according to the ICES data call. Follow recommendations from WKSHARK3 and 5 to address the following issues: data quality and onboard coverage; raising factors; discard retention patterns between fleets and countries; and consider the output of WKSURVIVE to address discard survival and advise on how to include discard information in the assessment and advice accordinly;
h) Carry out exploration analysis of effort data for stocks where time-series of effort may be used to decide on the application of the PA buffer. The use of effort data analysed in other ICES working groups should be favored, liaise with WGMIXFISH and WGSFD.
i) Further develop MSY proxy reference points relevant for elasmobranchs and explore/apply in MSY Proxies analyses for selected stocks;
j) Further develop the ToR for a proposed joint ICCAT-ICES meeting on porbeagle and other pelagic sharks.
k) Work intersessionally to draft/update stock annexes and then develop a procedure an schedule for subsequent reviews
l) Evaluate available data at species-specific level within the common skate-complex (*Dipturus* spp.) stock units in order to further increase our understanding of each individual species and their current status."

The assessments will be carried out on the basis of the stock annex in National Laboratories, prior to the meeting.

The assessments must be available for audit on the first day of the meeting.

Material and data relevant for the meeting must be available to the group no later than 14 days prior to the starting date.

WGEF will report by 9 August 2021 for the attention of ACOM.

Only experts appointed by national Delegates or appointed in consultation with the national delegates of the expert's country can attend this Expert Group

1.2 Background and history

The Study Group on Elasmobranch Fishes (SGEF), having been first established in 1989 (ICES, 1989), was re-established in 1995 and had meetings or met by correspondence in subsequent years (ICES, 1995–2001). Assessments for elasmobranch species had been hampered by a lack of data. The 1999 meeting was held concurrently with an EC-funded Concerted Action Project meeting (FAIR CT98-4156) allowing greater participation from various European institutes. Exploratory assessments were carried out for the first time at the 2002 SGEF meeting (ICES, 2002), covering eight of the nine case-study species considered by the EC-funded DELASS project (CT99-055). The success of this meeting was due largely to the DELASS project, a three-year collaborative effort involving 15 fisheries research institutes and two subcontractors (Heessen, 2003). Though much progress was made on methods, there was still much work to be done, with the paucity of species-specific landings data a major data issue.

In 2002, SGEF recommended the group be continued as a working group. The medium-term remit of this group being to extend the methods and assessments for elasmobranchs prepared by the EC-funded DELASS project; to review and define data requirements (fishery, survey and biological parameters) for stock identification, analytical models and to carry out such assessments as are required by ICES customers.

In 2003, WGEF met in Vigo, Spain and worked to further the stock assessment work carried out under DELASS. In 2003, landings data were collated for the first time. This exercise was based on data from ICES landings data, the FAO FISHSTAT database, and data from national scientists (ICES, 2003). In 2004, WGEF worked by correspondence to collate and refine catch statistics for all elasmobranchs in the ICES area. This task was complicated by the use (by many countries) of generic reporting categories for sharks, dogfish, skates and rays. WGEF evaluated sampling plans and their usefulness for providing assessment data (ICES, 2004).

In 2005, WGEF came under ACFM and was given the task of supporting the advisory process. This was because ICES has been asked by the European Commission to provide advice on certain species. This task was partly achieved by WGEF in that preliminary assessments were provided for spurdog, kitefin shark, thornback ray (North Sea) and deep-water sharks (combined). ACFM produced advice on these species, as well as for basking shark and porbeagle, based on the WGEF Report. A standard reporting and presentation format was adopted for catch data and best estimates of catch by species were provided for the first time (ICES, 2005).

In 2006, work continued on refining landings data and collating available biological data (ICES, 2006). Work was begun on developing standard reporting formats for length–frequency, maturity and CPUE data.

In 2007, WGEF met in Galway, with the demersal elasmobranchs of three ecoregions (North Sea, Celtic Seas and Bay of Biscay/Iberian waters) subject to more detailed study and assessment (ICES, 2007), with special emphasis on skates (given that these are generally the more commercially valuable demersal elasmobranchs in shelf seas). It should be noted, however, that though there have been some historical tagging studies (and indeed there are also on-going tagging and genetic studies), current knowledge of the stock structure and identity for many of these species is poor, and in most instances the assumed stock area equates with management areas.

WGEF met twice in 2008, firstly in parallel with WGDEEP (March 2008) to update assessments and advice for deep-water sharks and demersal elasmobranchs, and then with the ICCAT shark subgroup in Madrid (September 2008) to address North Atlantic stocks of shortfin mako and blue shark, and to further refine data available for the NE Atlantic stock of porbeagle (ICES, 2008).

In June 2009, WGEF held a joint meeting with the ICCAT SCRS Shark subgroup at ICES headquarters (Copenhagen). This meeting successfully pooled all available data on North Atlantic porbeagle stocks (ICES, 2009). In addition, updated assessments were carried out for North Sea, Celtic Seas, and Biscay and Iberian demersal elasmobranchs and for the deep-water sharks *Centrophorus squamosus* and *Centroscymnus coelolepis*. A three-year assessment schedule was also agreed.

In June 2010, WGEF met in Horta, Portugal. This meeting was a full assessment meeting and stock updates were carried out for 19 species or species groups (ICES, 2010b), with draft advice provided for eight stocks. In addition, three special requests from the EC, relating to new advice on five elasmobranch species, were answered.

In June 2011, WGEF met at ICES Headquarters Copenhagen. Although this was not an advice year, advice was provided for *Squalus acanthias*. This was the result of a benchmark assessment of this species carried out via correspondence during spring 2011. The updated model was used to provide F_{MSY}-based advice for the first time. A special request from NEAFC, on sharks and their categorisation by habitat was also addressed (ICES, 2011b).

In June 2012, WGEF met at IPMA in Lisbon (ICES, 2012b). This meeting was a full assessment meeting during which both stock updates and draft advice were provided. Two special requests, one from NEAFC and the other from the NWWRAC (via the EC), were also answered. WGEF also met in Lisbon the following year (ICES, 2013a) with preparatory work and exploratory analyses conducted, in addition to addressing some special advice requests from the EU.

From 2014, it was decided with ICES that advice would be staggered, with the main stocks divided across alternating years and with advice for prohibited and most of the zero-TAC stocks done once every four years. In 2014, WGEF assessed and provided draft advice for skates (Rajidae) in the Celtic Seas and Biscay-Iberian ecoregions (ICES, 2014), and the following year (2015) WGEF examined skates in the North Sea ecoregion and Azorean waters, as well as various sharks: Portuguese dogfish, leafscale gulper shark, kitefin shark, smooth-hounds, tope, catsharks, angel shark, porbeagle and basking shark (ICES, 2015).

Overall the working group has been successful in maintaining participation from a wide range of countries, although the number of active participants declined slightly in 2016, for various reasons. Nevertheless, over the longer-term, attendance at WGEF has been at a stable level in recent years, with participation from quantitative assessment scientists, fishery managers, survey scientists and elasmobranch biologists.

In 2020 and 2021, WGEF met online due to COVID-19 restrictions. For the 2020 working group, data submission and processing had been altered to reduce issues in terms of data call interpretation as well as the delivery of non-uniform data sets. The WGEF 2020 data were submitted to InterCatch for the first time, extracted and processed using R-code available in TAF. Next landings data are collated to the landings spreadsheet containing the historical landings data. This process was repeated in 2021 using the 2020 landings data. Furthermore, issues in terms of harmonisation of fleet names, stock codes and species codes of historic landings data was performed. Also, an important step towards the use of discard data in the advice was taken. Available discard data on the accessions folder and those submitted to InterCatch for the years 2019 and 2020 were combined into a discard table. Next steps should include an automated process of cleaning up the data, having a quality assessment and control of the submitted discard data.

1.3 Planning of the work of the group

Given the large number of stocks that WGEF addresses, WGEF and the ICES Secretariat have developed the following timeframe for advice.

In 2019, the following species and stocks with quadrennial advice were addressed (Table 1.1). These stocks will be addressed again in 2023:

- Common skate in the greater North Sea ecoregion
- Starry ray in the greater North Sea ecoregion
- Leafscale gulper shark in the Northeast Atlantic;
- Kitefin shark in the Northeast Atlantic;
- Portuguese dogfish in the Northeast Atlantic;
- Angel shark in the Northeast Atlantic;
- Porbeagle in the Northeast Atlantic;
- Basking shark in the Northeast Atlantic;
- Thresher sharks in the Northeast Atlantic;
- White skate in the Northeast Atlantic.

In 2020, the following species and stocks were addressed for advice (Table 1.2). These stocks will be addressed again in 2022:

- Spurdog in the Northeast Atlantic;
- Skates and rays (Rajidae) in the Celtic Seas (ICES subareas 6 and 7 except Division 7.d);[1]
- Skates and rays (Rajidae) in the Bay of Biscay and Iberian Coast (ICES Subarea 8 and Division 9.a).

In 2021, the following species and stocks were assessed and advice drafted (Table 1.3). These stocks will be addressed again in 2023:

- Skates and rays (Rajidae) in the Greater North Sea, (including Skagerrak, Kattegat and eastern Channel) (eight ICES assessment units including 'other rays and skates');
- Skates and rays (Rajidae) in the Azores and Mid-Atlantic Ridge (mainly *R. clavata*);
- Smooth-hounds in the Northeast Atlantic;
- Tope in the Northeast Atlantic;
- Catshark stocks in the Northeast Atlantic (seven ICES stock assessment units);

[1] Note: Skate stocks that straddle divisions 7.d and 7.e are included within the Celtic Sea section and advice. Skate species that straddle Division 4.c and Division 7.d are included within the North Sea section and advice.

Table 1.1. Elasmobranch stocks with quadrennial assessments and advice carried out in 2019

ICES stock code	Stock name	Ecoregion	Advice updated	Advice
rjb.27.3a4	Common skate (*Dipturus batis*-complex) in Subarea 4 and Division 3.a (North Sea and Skagerrak)	North Sea	2019	Quadrennial
rjr.27.23a4	Starry ray (*Amblyraja radiata*) in Subareas 2, 3.a and 4 (Norwegian Sea, Skagerrak, Kattegat and North Sea)	North Sea	2019	Quadrennial
agn.27.nea	Angel shark (*Squatina squatina*) in the Northeast Atlantic	Widely distributed and migratory stocks	2019	Quadrennial
bsk.27.nea	Basking shark (*Cetorhinus maximus*) in the North-east Atlantic	Widely distributed and migratory stocks	2019	Quadrennial
cyo.27.nea	Portuguese dogfish (*Centroscymnus coelolepis*) in the Northeast Atlantic	Widely distributed and migratory stocks	2019	Quadrennial
guq.27.nea	Leafscale gulper shark (*Centrophorus squamosus*) in the Northeast Atlantic	Widely distributed and migratory stocks	2019	Quadrennial
por.27.nea	Porbeagle (*Lamna nasus*) in the Northeast Atlantic	Widely distributed and migratory stocks	2019	Quadrennial
rja.27.nea	White skate (*Rostroraja alba*) in the Northeast Atlantic	Widely distributed	2019	Quadrennial
sck.27.nea	Kitefin shark (*Dalatias licha*) in the Northeast Atlantic	Widely distributed and migratory stocks	2019	Quadrennial
thr.27.nea	Thresher sharks (*Alopias* spp.) in Subareas 10, 12, Divisions 7.c-k, 8.d-e, and Subdivisions 5.b.1, 9.b.1, 14.b.1 (Northeast Atlantic)	Widely distributed	2019	Quadrennial

Table 1.2. Elasmobranch stocks for which assessments and advice was provided in 2020.

ICES stock code	Stock name	Ecoregion	Advice updated	Advice
dgs.27.nea	Spurdog (*Squalus acanthias*) in the Northeast Atlantic	Widely distributed	2020	Biennial
raj.27.67a-ce-h	Other skates and rays in Subareas 6 and 7 (excluding 7.d)	Celtic Seas	2020	Biennial
raj.27.89a	Other skates and rays in Subarea 8 and Division 9.a (Bay of Biscay and Atlantic Iberian waters)	Bay of Biscay and Iberian coast	2020	Biennial
rjb.27.67a-ce-k	Common skate complex (flapper skate (*Dipturus batis*) and blue skate (*Dipturus intermedius*)) in Subareas 6 and 7 (excluding 7.d)	Celtic Seas	2020	Biennial
rjb.27.89a	Common skate (*Dipturus batis*-complex) in Subarea 8 and Division 9.a (Bay of Biscay and Atlantic Iberian waters)	Bay of Biscay and Iberian coast	2020	Biennial
rjc.27.6	Thornback ray (*Raja clavata*) west of Scotland (Subarea 6)	Celtic Seas	2020	Biennial
rjc.27.7afg	Thornback ray (*Raja clavata*) in Divisions 7a.f.g (Irish and Celtic Sea)	Celtic Seas	2020	Biennial
rjc.27.7e	Thornback ray (*Raja clavata*) in Division 7.e (Western English Channel)	Celtic Seas	2020	Biennial
rjc.27.8	Thornback ray (*Raja clavata*) in Subarea 8 (Bay of Biscay and Cantabrian Sea)	Bay of Biscay and Iberian coast	2020	Biennial
rjc.27.9a	Thornback ray (*Raja clavata*) in Division 9.a (west of Galicia, Portugal, and Gulf of Cadiz)	Bay of Biscay and Iberian coast	2020	Biennial

ICES stock code	Stock name	Ecoregion	Advice updated	Advice
rje.27.7de	Small-eyed ray (*Raja microocellata*) in the English Channel (Divisions 7.d.e)	Celtic Seas	2020	Biennial
rje.27.7fg	Small-eyed ray (*Raja microocellata*) in Divisions 7.f.g (Bristol Channel)	Celtic Seas	2020	Biennial
rjf.27.67	Shagreen ray (*Leucoraja fullonica*) in Subareas 6 and 7 (Celtic Sea and West of Scotland)	Celtic Seas	2020	Biennial
rjh.27.7afg	Blonde ray (*Raja brachyura*) in Divisions 7.a.f.g (Irish and Celtic Sea)	Celtic Seas	2020	Biennial
rjh.27.7e	Blonde ray (*Raja brachyura*) in Division 7.e (western English Channel)	Celtic Seas	2020	Biennial
rjh.27.9a	Blonde ray (*Raja brachyura*) in Division 9.a (west of Galicia, Portugal, and Gulf of Cadiz)	Bay of Biscay and Iberian coast	2020	Biennial
rji.27.67	Sandy ray (*Leucoraja circularis*) in Subareas 6 and 7 (Celtic Sea and West of Scotland)	Celtic Seas	2020	Biennial
rjm.27.67bj	Spotted ray (*Raja montagui*) in Subarea 6 and Divisions 7.b.j (west of Scotland and Ireland)	Celtic Seas	2020	Biennial
rjm.27.7ae-h	Spotted ray (*Raja montagui*) in Divisions 7.a.e.f.g.h (southern Celtic seas)	Celtic Seas	2020	Biennial
rjm.27.8	Spotted ray (*Raja montagui*) in Subarea 8 (Bay of Biscay and Cantabrian Sea)	Bay of Biscay and Iberian coast	2020	Biennial
rjm.27.9a	Spotted ray (*Raja montagui*) in Division 9.a (west of Galicia, Portugal, and Gulf of Cadiz)	Bay of Biscay and Iberian coast	2020	Biennial
rjn.27.678abd	Cuckoo ray (*Leucoraja naevus*) in Subareas 6 and 7 (Celtic Sea and West of Scotland) and Divisions 8.a.b.d (Bay of Biscay)	Celtic Seas/Biscay	2020	Biennial
rjn.27.8c	Cuckoo ray (*Leucoraja naevus*) in Division 8.c (Cantabrian Sea)	Bay of Biscay and Iberian coast	2020	Biennial
rjn.27.9a	Cuckoo ray (*Leucoraja naevus*) in Division 9.a (west of Galicia, Portugal, and Gulf of Cadiz)	Bay of Biscay and Iberian coast	2020	Biennial
rju.27.7bj	Undulate ray (*Raja undulata*) in Divisions 7.b.j (Southwest of Ireland)	Celtic Seas	2020	Biennial
rju.27.7de	Undulate ray (*Raja undulata*) in Divisions 7.d.e (English Channel)	Celtic Seas	2020	Biennial
rju.27.8ab	Undulate ray (*Raja undulata*) in Divisions 8.a.b (Bay of Biscay)	Bay of Biscay and Iberian coast	2020	Biennial
rju.27.8c	Undulate ray (*Raja undulata*) in Divisions 8.c (Cantabrian Sea)	Bay of Biscay and Iberian coast	2020	Biennial
rju.27.9a	Undulate ray (*Raja undulata*) in Division 9.a (west of Galicia, Portugal, and Gulf of Cadiz)	Bay of Biscay and Iberian coast	2020	Biennial

Table 1.3. Elasmobranch stocks scheduled for assessments and advice in 2021.

ICES stock code	Stock name	Ecoregion	Advice updated	Advice
gag.27.nea	Tope (*Galeorhinus galeus*) in the Northeast Atlantic	Widely distributed and migratory stocks	2019	Biennial
raj.27.3a47d	Other skates and rays in the North Sea ecoregion (Subarea 4, and Divisions 3.a and 7.d)	North Sea	2019	Biennial
raj.27.1012	Rays and skates (mainly thornback ray) in the Azores and Mid-Atlantic Ridge	Widely distributed and migratory stocks	2019	Biennial
rjc.27.3a47d	Thornback ray (*Raja clavata*) in Subarea 4, and Divisions 3.a and 7.d (North Sea, Skagerrak, Kattegat and eastern English Channel)	North Sea	2019	Biennial
rjh.27.4a6	Blonde ray (*Raja brachyura*) in Division 4a and Subarea 6 (Northern North Sea and west of Scotland)	North Sea	2019	Biennial
rjh.27.4c7d	Blonde ray (*Raja brachyura*) in Divisions 4c and 7.d (Southern North Sea and eastern English Channel)	North Sea	2019	Biennial
rjm.27.3a47d	Spotted ray (*Raja montagui*) in Subarea 4, and Divisions 3.a and 7.d (North Sea, Skagerrak, Kattegat, and Eastern English Channel)	North Sea	2019	Biennial
rjn.27.3a4	Cuckoo ray (*Leucoraja naevus*) in Subarea 4 and Division 3.a (North Sea and Skagerrak and Kattegat)	North Sea	2019	Biennial
sdv.27.nea	Starry smooth-hound (*Mustelus* spp.) in the Northeast Atlantic	Widely distributed and migratory stocks	2019	Biennial
sho.27.67	Black-mouth dogfish (*Galeus melastomus*) in Subareas 6 and 7 (Celtic Sea and West of Scotland)	Celtic Seas	2019	Biennial
sho.27.89a	Black-mouth dogfish (*Galeus melastomus*) in in Subarea 8 and Division 9.a (Bay of Biscay and Atlantic Iberian waters)	Bay of Biscay and Iberian seas	2019	Biennial
syc.27.3a47d	Lesser-spotted dogfish (*Scyliorhinus canicula*) in Subarea 4, and Divisions 3.a and 7.d (North Sea, Skagerrak, Kattegat, and Eastern English Channel)	North Sea	2019	Biennial
syc.27.67a-ce-j	Lesser-spotted dogfish (*Scyliorhinus canicula*) in Subarea 6 and Divisions 7.a–c. e–j (Celtic Seas and west of Scotland)	Celtic Seas	2019	Biennial
syc.27.8abd	Lesser-spotted dogfish (*Scyliorhinus canicula*) in Divisions 8.a,b,d (Bay of Biscay)	Bay of Biscay and Iberian seas	2019	Biennial
syc.27.8c9a	Lesser-spotted dogfish (*Scyliorhinus canicula*) in Divisions 8.c and 9.a (Atlantic Iberian waters)	Bay of Biscay and Iberian seas	2019	Biennial
syt.27.67	Greater-spotted dogfish (*Scyliorhinus stellaris*) in Subareas 6 and 7 (Celtic Sea and West of Scotland)	Celtic Seas	2019	Biennial

1.4 ICES approach to F_{MSY}

Most elasmobranch species are slow growing, with low population productivity. Some species (e.g. basking shark) are on several lists of 'threatened' or 'endangered' species. They may also be listed under international trade agreements such as the Convention on the International Trade on Endangered Species (CITES), which may place limitations on fishing for or trade in these species. Because of this, it is not believed that F_{MSY} is an appropriate or achievable target in all cases, particularly in the short term. However, the ICES F_{MSY} methodology has evolved in recent years. For example, new methods that are more appropriate for data-deficient stocks have been developed, and there is a greater interest in considering generation time into such methods and for the provision of advice. The generation time of elasmobranchs is often much longer than most teleosts. For each assessed stock, the ICES precautionary approach is considered, and the group's approach and considerations are outlined in the stock summary sheets of the advice. Since 2017, WGEF has explored several data-poor assessment methods to selected ray stocks. These methods produced promising results, but will require some adjustment to account for elasmobranch life history and fisheries dynamics. In 2018 and 2019, progress was made with applying MSY proxies to elasmobranch stocks. Following the recommendations made in 2018, WGEF further explored the application of proxy MSY reference points to elasmobranch fishes. Full information on this analysis is available in Miethe (2019, WGEF WD, see Annex 6). In 2020, an exploratory analysis of two different production models applied to North Sea and English Channel Rajidae stocks was presented. The analysis highlighted the importance of improving the availability of catch data and as such touches on the issue of having reliable discard estimates.

1.5 Community plan of action for sharks

An Action Plan for the Conservation and Management of Sharks (EU, 2009) was adopted by the European Commission in 2009. Further details on this plan and its relevance to WGEF can be found in an earlier report (ICES, 2009).

1.6 Conservation advice

Several terms are used to define stock status, particularly at low levels. Some of these terms mean different things to different people. Therefore, WGEF takes this opportunity to define how terms are used within this report, and also how WGEF believe these terms should be used when providing advice.

In addition, several elasmobranch species are listed as 'prohibited species' or as species that cannot be retained in European Council Regulations fixing annual fishing opportunities (CEC, 2021). Although this may be appropriate, WGEF believes that this status should only be used for long-term conservation, whilst a (near) zero TAC may be more appropriate for short-term management.

These ideas are discussed in detail below.

Extinction vs. extirpation

Extinction is defined as "*The total elimination or dying out of any plant or animal species, or a whole group of species, worldwide*" (Chambers Dictionary of Science and Technology), yet increasingly the term 'extinct' is used in conservation and scientific literature to highlight the disappearance of a species from a particular location or region, even if the area is at the periphery of the main geographical range.

Additionally, some of the studies that have reported a species to be (locally or regionally) 'extinct' can be based on limited data, with supporting data often neither spatially nor temporally comprehensive enough to confirm the loss, especially with regards to species that are wide-ranging, small-bodied and/or cryptic, or distributed in habitats that are difficult to survey.

In terms of a standardized approach to the terminology of lost species, WGEF consider the following:

Extinct: When an animal or plant species has died out over its entire geographical range.

Extirpated: When an animal or plant species has died out over a defined part of its range, from where it was formerly a commonly occurring species. This loss should be due, whether directly or indirectly, to anthropogenic activities.

If anthropogenic activities are not considered to have affected the loss of the species, then the species should be considered to have 'disappeared' or been lost from the area in question. The term 'extirpated' should also be used to identify the loss of the species from part of the main geographical range or habitat, and therefore be distinguished from a contraction in the range of a species, where it has been lost from the fringes of its distribution or suboptimal habitat.

Additionally, the terms 'extinct' and 'extirpated' should be used when there has been sufficient, appropriate survey effort (i.e. operating at the relevant temporal and spatial scale and with an appropriate survey or census method) to declare the species extinct/extirpated. Prior to this time, these terms could be prefixed near- or presumed.

Presumed extinct/extirpated should be used when the species has not been recorded in available survey data (which should operate at an appropriate temporal and spatial scale), but when dedicated species-specific surveys have not been undertaken.

Near extinct/extirpated should be used when there are isolated reports of the species existing in the geographical area of interest.

In terms of ICES advice, the term 'extinct' was used in both 2005 and 2006 to describe the status of angel shark in the North Sea; although since 2008 the term 'extirpated' has been used.

The utility of the Prohibited species list on TAC and quotas regulations

The list of prohibited species on the TACs and quotas regulations (e.g. EC, 2021) is an appropriate measure for trying to protect the marine fish of highest conservation importance, particularly those species that are also listed on CITES and various other conservation conventions. Additionally, there should be sufficient concern over the population status and/or impacts of exploitation that warrants such a long-term conservation strategy over the whole management area.

There are some species that would fall into this category. For example, white shark and basking shark are both listed on CITES and some European nations have given legal protection to these species. Angel shark has also been given legal protection in UK.

It should also be recognized that some species that are considered depleted in parts of their range may remain locally abundant in some areas, and such species might be able to support low levels of exploitation. From a fisheries management viewpoint, advice for a zero or near-zero TAC, or for no target fisheries, is very different from a requirement for 'prohibited species' status, especially as a period of conservative management may benefit the species and facilitate a return to commercial exploitation in the short term.

Additionally, there is a rationale that a list of prohibited species should not be changing regularly, as this could lead to confusion for both the fishing and enforcement communities. The STECF meeting on management of skates and rays has recommended issuing guidelines for the inclusion and removal of species on the prohibited species list (STECF, 2017).

In 2009 and 2010, undulate ray, *Raja undulata* was moved on to the prohibited species list. This had not been advised by ICES. Following a request from commercial fishers, the European Commission asked ICES to give advice on this listing. ICES reiterated that undulate ray would be better managed under local management measures and that there was no justification for placing undulate ray on the prohibited species list. There have been subsequent changes in the listing of this species. It was removed from the Prohibited Species List for Subarea 7 in 2014 (albeit as a species that cannot be retained or landed). In 2015, undulate ray was only maintained in the prohibited species list in subareas 6 and 10. Small TACs were established for stocks in the English Channel and Bay of Biscay in 2015 and for the stock in the Iberian ecoregion in 2016. During the 2018 meeting, the advice for 2016–2017 was recalculated following a request from France (ICES, 2018b).

In 2019, the list of prohibited species in the TACs and quota regulations was amended. An extensive list of prohibited species, including white shark, basking shark and hammerhead sharks have been taken up in the regulation on the conservation of fisheries resources and the protection of marine ecosystems through technical measures (EU regulation 2019/1241).

1.7 Sentinel fisheries

ICES advice for several elasmobranch stocks suggests that their fisheries should, for example "*consist of an initial low* (level) *scientific fishery*". In discussions of such fisheries, WGEF would suggest that a 'sentinel fishery' is a science-based data collection fishery conducted by commercial fishing vessel(s) to gather information on a specific fishery over time using a commercial gear but with standardized survey protocols. Sentinel fisheries would:

- Operate with a standardized gear, defined survey area, and standardized index of effort;
- Aim to provide standardized information on those stocks that may not be optimally sampled by existing fishery-independent surveys;
- Include a limited number of vessels;
- Be subject to trip limits and other technical measures from the outset, in order to regulate fishing effort/mortality in the fishery;
- Carry scientific observers on a regular basis (e.g. for training purposes) and be collaborative programmes with scientific institutes;
- Assist in biological sampling programmes (including self-sampling and tagging schemes);
- Sampling designs, effort levels and catch retention policy should be agreed between stakeholders, national scientists and the relevant ICES assessment expert group.

1.8 Mixed fisheries regulations

Apart from TAC regulations, several ICES divisions have fish stocks subject to recovery plans, including the cod recovery plan, hake recovery plan, etc.

As several elasmobranch stocks, particularly skates and rays, are caught in mixed fisheries within these areas catches of elasmobranchs may be limited by restrictive effort limitations because of these plans. In general, these are not referred to within the text, but must be taken into consideration when looking at landings trends from within these areas.

1.9 Current ICES expert groups of relevance to the WGEF

Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK)

Several elasmobranchs are taken in North Sea demersal fisheries, including spurdog (Section 2), tope (Section 10), various skates (Section 15) and starry smooth-hound (Section 21).

WGNSSK should note that the Greater Thames Estuary is the main part of the North Sea distribution of thornback ray *Raja clavata* and may also be an important nursery ground for some small shark species, such as tope and starry smooth-hound. Thornback ray is an important species in ICES Division 4.c, and is taken as bycatch in fisheries targeting sole (e.g. trawl and gillnet), cod (e.g. trawl, gillnet and longline), as well as in targeted fisheries.

The Wash may also be an area of ecological importance for some elasmobranchs, including thornback ray and tope.

Working Group for the Celtic Seas Ecoregion (WGCSE)

Several elasmobranchs are taken in the waters covered by WGCSE, including spurdog (Section 2), tope (Section 10), various skates and rays (Section 18) and starry smooth-hound (Section 21).

WGCSE should note that common skate *Dipturus batis*-complex, which has declined in many inshore areas of northern Europe, may be locally abundant in parts of ICES Division 6.a and the deeper waters of the Celtic Sea (Division 7.h-j). Thornback ray is abundant in parts of the Irish Sea, especially Solway Firth, Liverpool Bay and Cardigan Bay. The Lleyn Peninsula is an important ground for greater-spotted dogfish *Scyliorhinus stellaris*. WGSCE should also note that the Bristol Channel is of high local importance for small-eyed ray *Raja microocellata*, as well as being an important nursery ground for some small sharks (e.g. starry smooth-hound and tope) and various skates.

Angel shark (Section 22) was formerly abundant in parts of Cardigan Bay, the Bristol Channel and Start Bay, and is now observed very rarely. Similarly, white skate (Section 23) was historically present in this ecoregion, and may be near-extirpated from most parts of the ecoregion.

Working Group on the Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP)

In 2008, WGEF met in parallel with WGDEEP in order to assess and provide advice on deep-water sharks (see sections 3–5). In February 2010, WGDEEP held a benchmark assessment of deep-water stocks (WKDEEP; ICES, 2010a). Two WGEF members attended in order to carry out an assessment of the deep-water shark species *Centrophorus squamosus* and *Centroscymnus coelolepis*. Considerable progress was made in robust construction of a plausible catch and effort history for both species. A novel approach to assessing such species as deep-water sharks was presented at the meeting using a subset of the data on Portuguese dogfish and was agreed by WKDEEP to be a highly promising approach, pending the acceptable reconstruction of the aforementioned catch and effort data. Further development and possible future application of the method is to be encouraged. Several members of WGEF also attend WGDEEP, so facilitating the exchange of knowledge between the two expert groups.

International Bottom-trawl Survey Working Group (IBTSWG) and Working Group on Beam Trawl Surveys (WGBEAM)

IBTSWG continue to provide maps of the distribution of a variety of demersal elasmobranchs from the IBTS surveys in the North Sea and western areas. WGEF consider that these plots provide useful information and hope that IBTSWG will continue to provide these plots as routine outputs in the future. WGBEAM carries out some analysis of catch rates and distribution of

certain skate species from beam trawl surveys in the North Sea and Celtic Seas ecoregions. Such analyses are very useful for WGEF.

There are some inaccuracies in the identifications of some skates in various trawl surveys, as well as some recent taxonomic revisions. Hence, more collaborative studies and exchange between WGEF and WGBEAM to address such issues is encouraged.

Workshop on the Inclusion of Discard Survival in Stock Assessments (WKSURVIVE)

The first workshop is planned in February 2021. Important objectives of this Workshop for WGEF is to explore the incorporation of discard survival estimates in stock assessments as well as to review the various approaches taken to integrate discard estimates in current assessments in the context of applying discard survival estimates.

One of the recurring issues in WGEF is the uncertainty in discard data as a result of the high number of discrepancies between years and inconsistent or missing data. Despite having had two dedicated workshops on the use of discard data in stock assessments (WKSHARK 3 (ICES, 2017) and WKSHARK5 (ICES, 2020a)), it is still not possible to move forward on this issue. In addition, given the expected high survival of elasmobranchs, catch data (i.e. landings and estimated discards) will not equal dead removals. Hence the importance to understand the survival rate of discarded elasmobranchs in order to obtain a separate estimates for dead and surviving discards.

WGEF recommends to initiate a collaborative effort to address issues about the collection and registration of discard data and to evaluate the use of discard data, including survivability, for the application in future stock assessments. Hence, WGEF recommends members of the group to join WKSURVIVE.

1.10 Other meetings of relevance to WGEF

1.10.1 ICCAT

WGEF have conducted joint-meetings and assessments with ICCAT in 2008 (Madrid) and 2009 (ICES headquarters). These meetings were useful in pooling information on highly migratory pelagic shark species, including porbeagle, blue shark and shortfin mako. It is intended that these collaborations continue to usefully assess and update knowledge of pelagic shark species. ICCAT shark specialist subgroup also recommends maintaining links and sharing data with WGEF.

In 2012, a representative of WGEF attended the ICCAT Ecological Risk Assessment and shortfin mako stock assessment in Faro, Portugal. Data from this meeting were used in the WGEF account of shortfin mako (Section 9). In 2015, representatives of WGEF participated at the ICCAT blue shark stock assessment that was held in Lisbon, Portugal.

In 2016, representatives of ICCAT and WGEF attended the ICES Workshop to compile and refine catch and landings of elasmobranchs (WKSHARKS; ICES, 2016).

The ICCAT Shark Species Group held an intercessional meeting at Madeira in April 2016 (ICCAT, 2016). The ICCAT Shark Species Group intends to update stock assessments of Atlantic stocks of shortfin mako in 2017. ICCAT (2016) also suggested that updated porbeagle assessments should be undertaken in 2019.

A joint ICCAT-ICES meeting was planned for WGEF 2020, but due to COVID-19 measures an in-person meeting was not possible. ICCAT organized an online Atlantic porbeagle stock assessment meeting which was attended by members of WGEF. The meeting focused on the Northwest

Atlantic stock, and the Southwest and Southeast stocks. In 2022, the Northeast Atlantic stock will be benchmarked requiring a cooperative effort from ICCAT and WGEF.

WGEF considers that further collaborative meetings with the ICCAT Shark Species Group should continue. There is an initiative to carry out a joint ICCAT-ICES meeting to assess porbeagle and to invite ICCAT members in the upcoming porbeagle (por.27.nea) benchmark in 2022. A joint ICCAT-ICES meeting could also usefully address the data and assessment of thresher shark *Alopias* spp.

1.10.2 General Fisheries Commission for the Mediterranean (GFCM)

From 2010 to 2013, the GFCM carried out a programme to improve the knowledge and assess the status of elasmobranchs in the Mediterranean and the Black Sea. The main outcomes of this four-year programme were three meetings and two publications:

1. Expert Meeting on the status of elasmobranchs in the Mediterranean and Black Sea (Sfax, Tunisia, 20–22 September 2010);
2. Workshop on stock assessment of selected species of elasmobranchs (Brussels, Belgium, 12–16 December 2011);
3. Workshop on age determination (Antalya, Turkey, 8–12 October 2012);
4. Bibliographic review to sum up the information gathered during the above mentioned meetings (Bradai *et al.*, 2012); and
5. Publication of a technical manual on elasmobranch age determination (Campana, 2014).

In 2013, the GFCM decided to develop a three-year extension of this programme including the:

1. Preparation of a draft proposal on practical options for mitigating bycatch for the most impacting gears in the Mediterranean and Black Sea;
2. Production and dissemination of guidelines on good practices to reduce the mortality of sharks and rays caught incidentally by artisanal fisheries;
3. Development of studies on growth, reproduction, population genetic structure and post-released mortality and identification of critical areas (nurseries) at national or regional level;
4. Preparation of factsheets and executive summaries for some commercial species presenting identification problems;
5. Assessment of the impact of anthropogenic activities other than fisheries on the observed decline of certain sharks and ray populations;
6. Implementation of a pilot tagging programme for pelagic sharks.

WGEF consider that ICES and the GFCM would benefit from improved interaction due to the overlap in the distribution of certain stocks, and also in comparing stock assessment methods for data-limited stocks.

1.11 Relevant biodiversity and conservation issues

ICES work on elasmobranch fish is becoming increasingly important as a source of information to various multilateral environmental agreements concerning the conservation status of some species. Table 1.3 lists species occurring in the ICES area that are considered within these fora. An increasing number of elasmobranchs are 'prohibited' species in European fisheries regulations (CEC, 2019 and 2021), and these are summarised in Table 1.4.

Additionally, whilst not forming the basis of a legal instrument, the International Union for Conservation of Nature (IUCN) conduct Red List assessments of many species, including elasmobranchs, which has been undertaken at North-East Atlantic (Gibson *et al.*, 2008), Mediterranean (Cavanagh and Gibson, 2007; Abdul Malak *et al.*, 2011) and European scales (Nieto *et al.*, 2015). IUCN listings are summarised in the relevant species sections and are not discussed further in this section of the report.

1.11.1 OSPAR Convention

The OSPAR Convention (www.ospar.org) guides international cooperation on the protection of the marine environment of the Northeast Atlantic. It has 15 Contracting Parties and the European Commission represents the European Union. The OSPAR list of Threatened and/or Declining Species and Habitats, developed under the OSPAR Strategy on the Protection and Conservation of the Ecosystems and Biological Diversity of the Maritime Area, provides guidance on future conservation priorities and research needs for marine biodiversity at risk in the region. To date, eleven elasmobranch species are listed (Table 1.3), either across the entire OSPAR region or in areas where they were perceived as declining. Background Documents summarizing the status of these species are available (OSPAR Commission, 2010).

In 2020, ICES was requested to review and update OSPAR status assessments for stocks of listed shark, skates and rays in support of the OSPAR Quality Status Report 2023 (QSR2023) (WKSTATUS, ICES, 2020b). WKSTATUS has commented on whether the species continues to justify inclusion in the OSPAR List. The group concluded that it was not possible to ascertain a change for white skate, the deep-water species, basking shark and angel shark. Whereas the common blue skate appears to be slowly improving, the flapper skate may be more vulnerable to overfishing. In addition, it is recommended that both species are considered and listed separately. For porbeagle and spurdog assessment methodologies have improved and there appears to be small improvements in the population status, but this is as yet not fully quantified for porbeagle in the entire OSPAR area. Thornback and spotted rays have increased in abundance in the areas where they were previously considered depleted, and are considered not to continue to justify inclusion in the OSPAR List for this criterion. However, measures to address selectivity and discard survival should be further developed for these species.

1.11.2 Convention on the Conservation of Migratory Species (CMS)

CMS recognizes the need for countries to cooperate in the conservation of animals that migrate across national boundaries, if an effective response to threats operating throughout a species' range is to be made. The Convention actively promotes concerted action by the range states of species listed on its Appendices. The CMS Scientific Council has determined that 35 shark and ray species, globally, meet the criteria for listing in the CMS Appendices (Convention on Migratory Species, 2007). Table 1.3 lists Northeast Atlantic elasmobranch species that are currently included in the Appendices.

CMS Parties should strive towards strict protection of endangered species on Appendix I, conserving or restoring their habitat, mitigating obstacles to migration and controlling other factors that might endanger them. The range states of Appendix II species (migratory species with an unfavourable conservation status that need or would significantly benefit from international cooperation) are encouraged to conclude global or regional agreements for their conservation and management.

CMS now has a Sharks MOU, comprising an Advisory Committee (AC) and Intercessional Working Group (IWG).

1.11.3 Convention on International Trade in Endangered Species (CITES)

CITES was established in recognition that international cooperation is essential to the protection of certain species from overexploitation through international trade. It creates an international legal framework for the prevention of trade in endangered species of wild fauna and flora, and for the effective regulation of international trade in other species which may become threatened in the absence of such regulation.

Species threatened with extinction can be listed on Appendix I, which basically bans commercial, international trade in their products. Appendix II includes "*species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival*". Trade in such species is monitored closely and allowed if exporting countries can provide evidence that such trade is not detrimental to wild populations of the species.

Resolution Conf. 12.6 encourages parties to identify endangered shark species that require consideration for inclusion in the Appendices if their management and conservation status does not improve. Decision 13.42 encourages parties to improve data collection and reporting of catches, landings and trade in sharks (at species level where possible), to build capacity to manage their shark fisheries, and to take action on several species-specific recommendations from the Animals Committee (CITES, 2009).

1.11.4 Convention on the Conservation of European Wildlife and Natural Habitats (Bern convention)

The Bern Convention is a regional convention that provides a binding, international legal instrument that aims to conserve wild flora, fauna and natural habitats. Appendix II (or III) lists strictly protected (or protected) species of fauna (sometimes identified for the Mediterranean Sea only). Contracting Parties should "*take appropriate and necessary legislative and administrative measures to ensure the special protection of the wild fauna species specified in Appendix II*" and "*protection of the wild fauna species specified in Appendix II*".

Table 1.3. Elasmobranch species listed by Multilateral Environmental Agreements. Source; OSPAR (http://www.ospar.org/), CITES (https://cites.org/), CMS (http://www.cms.int/) and Bern Convention (http://www.coe.int/t/dg4/cultureheritage/nature/bern/default_en.asp).

Family	Species	Multinational Environmental Agreement			
		OSPAR	CMS	CITES	Bern
Squalidae	Spurdog *Squalus acanthias*	✓	App II (northern hemisphere populations		
Centrophoridae	Gulper shark *Centrophorus granulosus*	✓			
	Leafscale gulper shark *Centrophorus squamosus*	✓			
Somniosidae	Portuguese dogfish *Centroscymnus coelolepis*	✓			
Squatinidae	Angel shark *Squatina squatina*	✓			App III (Med)
Rhincodontidae	Whale shark *Rhincodon typus*		App II	App II	
Alopiidae	Pelagic thresher *Alopias pelagicus*		App II	App II	
	Bigeye Thresher *Alopias superciliosus*		App II	App II	
	Common Thresher *Alopias vulpinus*		App II	App II	
Cetorhinidae	Basking shark *Cetorhinus maximus*	✓	App I and II	App II	App II (Med)
Lamnidae	White shark *Carcharodon carcharias*		App I and II	App II	App II (Med)
	Shortfin mako shark *Isurus oxyrinchus*		App II		App III (Med)
	Longfin mako shark *Isurus paucus*		App II		
	Porbeagle shark *Lamna nasus*	✓	App II	App II	App III (Med)
Carcharhinidae	Silky shark *Carcharhinus falciformis*		App II	App II	
	Oceanic white-tip *Carcharhinus longimanus*			App II	
	Blue shark *Prionace glauca*				App III (Med)
Sphyrnidae	Scalloped hammerhead *Sphyrna lewini*		App II	App II	
	Great hammerhead *Sphyrna mokarran*		App II	App II	
	Smooth hammerhead *Sphyrna zygaena*			App II	

Table 1.3. (continued). Elasmobranch species listed by Multilateral Environmental Agreements.

Family	Species	Multinational Environmental Agreement			
		OSPAR	CMS	CITES	Bern
Pristidae	Sawfish *Pristidae*		App I and II	App I	
Rajidae	Common skate (*Dipturus batis*) complex	✓			
	Thornback ray *Raja clavata*	✓ North Sea			
	Spotted ray *Raja montagui*	✓ North Sea			
	White skate *Rostroraja alba*	✓			App III (Med)
Mobulidae	Reef manta ray *Manta alfredi*		App I and II		
	Giant manta ray *Manta birostris*		App I and II		
	Manta rays *Manta* spp.			App II	
	Longhorned mobula *Mobula eregoodootenkee*		App I and II	App II	
	Lesser devil ray *Mobula hypostoma*		App I and II	App II	
	Spinetail mobula *Mobula japanica*		App I and II	App II	
	Shortfin devil ray *Mobula kuhlii*		App I and II	App II	
	Giant devil ray *Mobula mobular*		App I and II	App II	App II (Med)
	Munk's (or pygmy) devil ray *Mobula munkiana*		App I and II	Ap II	
	Lesser Guinean devil ray *Mobula rochebrunei*		App I and II	App II	
	Chilean (or sicklefin) devil ray *Mobula tarapacana*		App I and II	App II	
	Smoothtail mobula *Mobula thurstoni*		App I and II	App II	

Table 1.4. Elasmobranch taxa listed as Prohibited Species on EU fisheries regulations. It is prohibited for EU vessels "*… to fish for, to retain on board, to tranship or to land …*" these species in certain areas within EU waters (Article 13) or, for certain species listed in Article 22, within the ICCAT Convention area. Adapted from CEC (2019; 2021).

Family	Species	Area
Centrophoridae	Leafscale gulper shark *Centrophorus squamosus*	EU waters of Division 2.a and subarea 4; EU and international waters of subareas 1 and 14
	Birdbeak dogfish *Deania calcea*	EU waters of Division 2.a and subarea 4; EU and international waters of subareas 1 and 14
Etmopteridae	Smooth lantern shark *Etmopterus pusillus*	EU waters of Division 2.a and subarea 4; EU and international waters of subareas 1, 5–8, 12 and 14
	Great lantern shark *Etmopterus princeps*	EU waters of Division 2.a and subarea 4; EU and international waters of subareas 1 and 14
Somniosidae	Portuguese dogfish *Centroscymnus coelolepis*	EU waters of Division 2.a and subarea 4; EU and international waters of subareas 1 and 14
Dalatiidae	Kitefin shark *Dalatias licha*	EU waters of Division 2.a and subarea 4; EU and international waters of subareas 1 and 14
Squatinidae	Angel shark *Squatina squatina*	EU waters
Alopiidae	Bigeye thresher shark *Alopias superciliosus*	ICCAT convention area
Cetorhinidae	Basking shark *Cetorhinus maximus*	All waters
Lamnidae	White shark *Carcharodon carcharias*	All waters
	Porbeagle shark *Lamna nasus*	All waters
Triakidae	Tope *Galeorhinus galeus*	When taken by longline in EU waters of Division 2.a and subarea 4, and EU and international waters of subareas 1, 5–8, 12 and 14.
Carcharhinidae	Silky shark *Carcharhinus falciformis*	ICCAT convention area
	Oceanic whitetip shark *Carcharhinus longimanus*	ICCAT convention area
	Hammerheads (Sphyrnidae), except for *Sphyrna tiburo*)	ICCAT convention area
Pristidae	Narrow sawfish *Anoxypristis cuspidata*	All waters
	Dwarf sawfish *Pristis clavata*	All waters
	Smalltooth sawfish *Pristis pectinata*	All waters
	Largetooth sawfish *Pristis pristis*	All waters
	Green sawfish *Pristis zijsron*	All waters
Rhinobatidae	All members of family	EU waters of subareas 1–12

Table 1.4. (continued). Elasmobranch taxa listed as Prohibited Species on EU fisheries regulations.

Family	Species	Area
Rajidae	Starry ray *Amblyraja radiata*	EU waters of Divisions 2.a, 3.a, 7.d and subarea 4
	Common skate (*Dipturus batis*) complex (*Dipturus cf. flossada and Dipturus cf. intermedia*)	EU waters of Division 2.a and subareas 3–4, 6–10.
	Norwegian skate *Dipturus nidarosiensis*	EU waters of subarea 6 and Divisions 7.a-c and 7e–h and 7.k
	Thornback ray *Raja clavata*	EU waters of Division 3.a
	Undulate ray *Raja undulata*	EU waters of subareas 6 and 10
	White skate *Rostroraja alba*	EU waters of subareas 6-10
Mobulidae	Reef manta ray *Manta alfredi*	All waters
	Giant manta ray *Manta birostris*	All waters
	Longhorned mobula *Mobula eregoodootenkee*	All waters
	Lesser (or Atlantic) devil ray *Mobula hypostoma*	All waters
	Spinetail mobula *Mobula japanica*	All waters
	Shortfin devil ray *Mobula kuhlii*	All waters
	Giant devil ray *Mobula mobular*	All waters
	Munk's (or pygmy) devil ray *Mobula munkiana*	All waters
	Lesser Guinean devil ray *Mobula rochebrunei*	All waters
	Chilean (or sicklefin) devil ray *Mobula tarapacana*	All waters
	Smoothtail mobula *Mobula thurstoni*	All waters

1.12 ICES fisheries advice

ICES advice is now provided under the Maximum Sustainable Yield framework (MSY).

Maximum sustainable yield is a broad conceptual objective aimed at achieving the highest possible yield over the long term (an infinitely long period of time). It is non-specific with respect to: (a) the biological unit to which it is applied; (b) the models used to provide scientific advice; and (c) the management methods used to achieve MSY.

The MSY concept can be applied to an entire ecosystem, an entire fish community, or a single fish stock. The choice of the biological unit to which the MSY concept is applied influences both the sustainable yield that can be achieved and the associated management options.

Implementation of the MSY concept by ICES will first be applied to individual fish stocks. Further information on the background to MSY and how it is applied to fish stocks by ICES can be found in the General Context to ICES Advice.

1.13 Data availability

General considerations

WGEF members agree that future meetings of WGEF should continue to meet in June, as opposed to meeting earlier in the year, as (a) more refined landings data are available; (b) meeting outside the main spring assessment period should provide national laboratories with more time to prepare for WGEF, (c) it will minimize potential clashes with other assessment groups (which could result in WGEF losing the expertise of stock assessment scientists) and (d) given that there are not major year-to-year changes in elasmobranch populations (cf. many teleost stocks), the advice provided would be valid for the following year.

The group agreed that survey data should be provided as disaggregated raw data, and not as compiled indices or data. The group agreed that those survey abundance estimates that are not currently in the DATRAS database are also provided as raw data by individual countries. It is recommended to have the data and code to calculate the survey indices to be made available on TAF (see other issues Section 27 in this report).

WGEF recommends that MS provide detailed explanations of how national data for species and length compositions are raised to total catch, especially when there may be various product weights reported (e.g. gutted or dressed carcasses and livers and/or fins).

ICES Data Call for landings data

Some of the data used in 2015 were submitted following the ICES Data Call. WGEF concluded that the format of the Data Call in that year, whereby some nations submitted individual files for each of the named stocks, was problematic, as it resulted in generic landings categories not being submitted by all nations and increased the workload of the group.

In 2016, the Data Call requested that nations submit a single file for all categories of elasmobranch in their national data for the period 2005–2015. The 2016 Data Call was viewed as successful and facilitated landings data (supplied by nearly all nations operating in the area of interest) to be supplied in a common format.

WGEF considered that the 2017 Data Call for landings data should be in the same format, but requesting only data for 2015 and 2016. It was also suggested that the 2017 Data Call request data earlier in the year (e.g. by the end of April), so that WGEF could undertake more data checks prior to the meeting. This format was followed in 2017, 2018 and 2019, but there were still considerable issues with data collation, formatting and QA that had to be addressed in the early stages of the meetings.

Since 2020, the data call requested nations to upload landings and discard data into InterCatch. The use of InterCatch facilitates data processing, improve transparency and allow members to conduct initial assessments prior to the meeting, removing a serious time-constraint.

Landings data

Landings data for years 2005 and later come from Data Calls (see above). WGEF uses some landings data extracted from ICES catch statistics, for time-series going back in time further than 2005. These data were mostly collated before 2005 although this task was hampered by the use by many countries of “nei” (not elsewhere identified) categories. Although strongly improving

over time, for all years, the Working Group's best estimates are still considered inaccurate for a number of reasons:

i. Quota species may be reported as elasmobranchs to avoid exceeding quota, which would lead to over-reporting;
ii. Fishers may not take care when completing landings data records, for a variety of reasons;
iii. Administrations may not consider that it is important to collect accurate data for these species;
iv. Some species could be underreported to avoid highlighting that bycatch is a significant problem in some fisheries;
v. Some small inshore vessels may target (or have a bycatch of) certain species and the landings of such inshore vessels may not always be included in official statistics.

WGEF aims to arrive at an agreed set of data for each species and will document any changes to these datasets in the relevant working group report. A Workshop to compile and refine catch and landings of elasmobranchs (WKSHARK2) was held in January 2016 (ICES, 2016), and following this, the 2016 Data Call requested a standardised approach to data submission, including for a longer period. Up to 2019, the experts in collaboration with national data coordinators inspected the spreadsheet and amended the landings table manually. These amended data are considered to be more accurate than official statistics as regional laboratories and WGEF members can better provide information on local fisheries and interpretation of nominal records of various species (including errors in species coding).

During the 2019 meeting, continuing issues with how the Data Call is interpreted, the non-uniformity of the dataset and as well as the many issues with species coding and stock allocations were discussed at length. A dedicated group met with the ICES Data Centre prior to the 2020 Data Call to explore options to facilitate the process of rendering a by the group accepted landings table before the start of WGEF. The group developed a more automated process using InterCatch and an R-coding procedure available in the Transparent Assessment Framework (TAF). The procedure to obtain the landings data is described in the 2020 WGEF report (ICES, 2020c). The issue list, stock allocation file and R-code is available on github: https://github.com/ices-taf/WGEF_catches.

Discards data

The EU requires Member States to collect discard data on elasmobranchs. This discarding may include both regulatory discarding, when quota is limited, as well as the discarding of smaller and less marketable individuals. Whilst WGEF want to make progress from 'landings' to 'catch'-based advice, data from discard observer programmes has, to date, mostly been used in exploratory and descriptive analyses and, in a few cases only, for advice purpose.

EU countries have implemented national on-board observer programs to estimate discards of abundant commercially important species (e.g. hake, *Nephrops*, cod, sole, and plaice). The adopted sampling designs have been defined considering the métiers, seasons and areas relevant for those species. As a consequence, national sampling programmes might not be optimal for estimating precise and unbiased discards for elasmobranchs.

In 2017, ICES WKSHARK3 reviewed i) the suitability of national sampling programs to estimate elasmobranch discards (including rare species), ii) the discard information available and iii) the procedures/methods to calculate population level estimates of discards removals for different countries (UCES, 2017).

In 2020, discard data over the period 2009 to 2019 were collected and merged into a single spreadsheet in Excel This year, the 2020 discard data were added, making discard data from 2009 to

2020 available and easily accessible. However, it was noted that for many stocks the discard data were incomplete for most of the years. In addition, raising to national catch levels is uncertain and procedures are not standardized. Particularly problematic are the cases of species which are not landed, i.e. being either not commercial or being subject to conservation measures (e.g. zero TAC). For some stocks (rju.27.7de, rju.27.8ab, rjn.27.8c, rjn.27.9a and syc.27.8abd) discard data are deemed reliable and have been included in the advice.

Yet, the main issues concerning the estimation of elasmobranch total discards are:

1. Data quality

Species identification, in particular that for rare species or species rarely seen in a particular area/national fleet or metier is a problematic issue. There are also suspected errors on species identification in various national datasets.

2. Insufficient sampling effort

As, in each fishing haul or set, elasmobranchs constitute a small and highly variable fraction of the catch the uncertainty of the mean discards rate is intrinsically high. This uncertainty can only be addressed by a significant increase in the coverage of on-board observations.

As an example, IPMA updated the work presented at the WKSHARK3 (Figueiredo *et al.*, 2017 WD). A classical ratio estimator (deGraft-Johnson, 1969), under a two-phase sampling scheme, was used to estimate the annual total discarded weight of *Raja clavata*, (period 2011–2014) from commercial vessels operating at ICES Division 9.a (Portugal mainland), with LOA larger than 12 m and with fishing permit to set gillnets or trammel nets. Using the variances of the estimates obtained, the optimum sample sizes to subsample in each phase were determined by considering the two variables (number of hauls with nets and total number/weight of *R. clavata* discards) and on the strength of the ratio relationship between them. Under a fixed cost function and the minimum MSE of the mean ratio estimate, the optimal sample size for second phase of the sampling scheme (i.e. on-board observations) should be increased from 256 to 678 times in relation to the sampling size levels of the years analysed in order to reduced uncertainty in discard estimates.

3. Raising factor

The discard estimators used varied between countries (ICES, 2017). While some are based on the fraction of fishing effort to the total effort in the metier, others are based on the fraction of the landings of the focal species to the total landings of that species in the metier, or on the landings of all or a number of commercially important species to the total landings of those species. The discard estimator adopted by each country is dependent upon the sampling plan and characteristics of the particular country, fleet or metier. It is thus extremely unlikely that a one-for-all estimator can be adopted. Nevertheless, reliable discard estimates need to be available to WGEF, so minimum levels of estimate precision should be agreed.

Considering the example of French fisheries, it was possible to compare the estimated discards using two raising methods: the raising to the landings of the same species (referred to as standard method in Table 1.6) and the raising to the landings of all species. See WKSHARK3 for details of the latter method (ICES, 2017).

For some stocks, estimates are similar and consistent. In particular for the stock rjc.27.3a4d, which is caught mostly in Division 7.d by French fisheries, both methods suggest discards of about 100 t per year until 2014 and a recent increase. Similar estimates were also obtained for greater-spotted dogfish in the Celtic sea. However, for two stocks of lesser-spotted dogfish, a species where identification is not a problem and which is abundant in the areas considered and marketed in France, estimates are very different with higher estimates derived from the standard method. These estimated high levels seem unrealistic and require more investigation. It may be that lesser-spotted dogfish is 100% discarded in some fishing operations and retained at various

levels depending on other factors, amongst which the catch of more valuable species. This effect might not apply to the greater-spotted dogfish, a larger more coastal species, caught predominately in small-scale fisheries.

Table 1.6. Discards estimates from different methods in French fisheries for one stock of thornback ray, two stocks of lesser spotted dogfish and three stocks of greater-spotted dogfish.

Stock	Method	2011	2012	2013	2014	2015	2016
rjc.27.347d	Standard	78	128	266	63	313	799
rjc.27.347d	All species	124	85	81	45	330	NA
syc.27.67	Standard*	3700	7372	3448	3770	4414	9600
	All species	2007	3527	2460	1728	2708	NA
syc.27.8abd	Standard	3342	4835	2497	4432	8616	8822
	All species	1182	1624	865	1266	2279	
	All species**	1371	1739	528	1255	2468	
syt.27.67	Standard	23	49	17	154	26	51
	All species	31	16	56	61	27	NA

*** Includes 7.d**

**** Métiers combined**

Discards estimates convey important information, for example estimates in the order of 1000 tonnes were obtained for the undulate ray in 7.de, compared to 20–70 tonnes per year of blonde ray in the western Channel. This broad comparison of the range of discards supports other evidence of much higher abundance of undulate ray compared to blonde ray in the English Channel.

4. Discard retention patterns

Discard-retention patterns change over time and between fleets and countries, and these changes can be associated with several different factors.

Biological communities are complex networks of species that change through time and space. Due to this, the spatial overlap between the target and secondary, or by-catch, species, caught by a certain fishery, is an important aspect that needs to be considered when estimating discards. In fact, as both target and non-target species are dynamic, the level of spatial overlap is likely to change with time even at small spatial scales.

Such spatial and temporal dynamics of fishing resources render estimates/predictions of catch and discard rates quite variable. This is exemplified by a Dutch (industry) study funded by the European Maritime and Fisheries Fund (2016–2018). In this study, vessels register and retain discards of quota regulated species by haul on-board. In the auction, the discards are sorted by species, measured and weighed. The results show that for the Dutch pulse fishery 80 to 90% of the rays are discarded. This high discard rate is mainly due to restrictive Dutch quota s for skates and rays.

In the case of elasmobranchs, some species may show highly seasonal variations in abundance or changes in local abundance. Single fishing vessels can show high variability in catch and discard rates between days of the week. Adding fishing fleet dynamics to the natural dynamics of target resources, the situation becomes even more complex and predictions of potential by-catch becomes even more uncertain. Given the restrictive quota for rays, Producer Organisations often take measures, e.g. setting a MLS limit the amount that can be landed per trip, to avoid an early exhaustion of the quota. Such measures may influence discard decisions in the fleet - especially

in the context of the Landing Obligation. Difficulties in accounting for decision making process on board undermine the accuracy and quality of discard estimates. This situation requires the development of adequate estimators that take those aspects in consideration, under penalty of obtaining highly imprecise discard estimates which in turn, may have significant social and economic impacts on fishing communities.

Market demand and management measures are important drivers for elasmobranch discards. For example, WKSHARK3 estimated that the retention of smooth-hound probably increased over time in UK fisheries and the discarding of thornback ray in the Channel increased in recent years (ICES, 2017). These behaviours are probably a consequence of market opportunities for smooth-hound and limited TAC for thornback ray.

5. Discard survival

Owing to the apparent high survival of elasmobranchs after capture it is important to obtain separate estimates for dead and surviving discards. As a proportion of the discards would be alive, catch data (landings and estimated discards) do not equate with "dead removals" in terms of population dynamics. Understanding the survival rates of discarded individuals is therefore fundamental for informing potential exemptions from the EU landings obligation.

To date there have been only limited scientific studies on the discard survival of skates in European fisheries, and data on the immediate, short-term survival and longer-term discard survival of these species are lacking for most fisheries. A summary of those studies was compiled in WKSHARK3 (ICES, 2017). To inform discussions on the future EU landing obligation and to improve the quantification of dead discards, WGEF recommend the need to implement scientific studies to better assess and quantify the discard survival of the main commercial skates caught by the trawl fleets, especially otter trawlers operating in the Bay of Biscay and Iberian waters, beam trawl fleets operating in northern Europe and for gill- and trammel net fisheries used by the inshore polyvalent fleet.

6. Progress

In 2017 and 2019, workshops were held to address the issues surrounding the use of discards in the elasmobranch assessments (ICES, 2017; 2020). It was addressed again by WGEF at the 2019 meeting and decided that the issue is too complex to be solved during a workshop or working group meeting and will require a concerted effort to solve. WGEF recommends to initiate a collaborative project to address this issue and has formulated a recommendation for ICES to initiate a dialogue with DG Mare to explore the possibility of funding to support a project to address the serious issues surrounding the collection and registration of discard data, as well as how to include survivability, in order for the data to be used in future stock assessments.

Stock structure

This report presents the status and advice of various demersal, pelagic and deep-water elasmobranchs by individual stock component. The identification of stock structure has been based upon the best available knowledge to date (see the stock-specific sections for more details). However, it has to be emphasized that overall, the scientific basis underlying the identity of many of these stocks is currently weak. In most cases, stock identification is based on the distribution and relative abundance of the species, current knowledge of movements and migrations, reproductive mode, and consistency with management units.

WGEF considers that the stock definitions proposed in the report are limited for many species, and in some circumstances advice may refer to 'management units'.

WGEF recommends that increased research effort be devoted to clarifying the stock structure of the different demersal and deep-water elasmobranchs being investigated by ICES.

Length measurements

Further information on the issues of different types of length measurement can be found in earlier reports (see Section 1.15 of ICES, 2010b). WGEF recommends that length–frequency information both commercial and survey be made available to the group for those species for which length-based assessments could be considered.

Taxonomic problems

Incorrect species identifications or coding errors affect many relevant data sets, including commercial data and even some scientific survey data. WGEF consistently attempt to correct and report these errors when they are found. The FAO recently produced an updated guide to the chondrichthyan fish of the North Atlantic (Ebert and Stehmann, 2013).

1.14 Methods and software

Many elasmobranchs are data-limited, and the paucity of data can extend to:

- Landings data, which are often incomplete or aggregated;
- Life-history data, as most species are poorly known with respect to age, growth and reproduction;
- Commercial and scientific datasets that are compromised by inaccurate species identification (with some morphologically similar species having very different life-history parameters);
- Lack of fishery-independent surveys for some species (e.g. pelagic species) and the low and variable catch rates of demersal species in existing bottom-trawl surveys.

Hence, the work undertaken by WGEF often precludes the formal stock assessment process that is used for many commercial teleost stocks. The analysis of survey, biological and landings data are used in most cases to evaluate the status of elasmobranch species/stocks. This limitation may be eased by new data-poor assessment approaches, which have the potential to allow some ray stocks to be moved from assessment category 3 to category 2.

Analytical assessment models are only used in the stock assessments of two species; porbeagle and spurdog. In 2011, WGEF updated and refined the model last used for the spurdog assessment in 2008 and 2010. A benchmark assessment of spurdog was carried out prior to, and during WGEF 2011. Further information can be found in Section 2 of the 2011 WGEF report (ICES, 2011a). In 2017, WGEF used length-based indicators (LBI) and the Surplus Production in Continuous Time (SPiCT) to conduct exploratory assessments for three stocks (rjc.27.3a47d, rjn.27.3a4 and rjn.27.678abd).

In 2020, two new methods were presented. The first approach applied a Surplus Production Model in Continuous Time (SPicT, Pedersen and Berg, 2017) and a State Space Bayesian Model (SSBM). Landings data before 2009 were based on FAO data, no discards data were available for this period. Landings and discards data from 2009 to 2018 were obtained from in WGEF available landing and discard data. Cause of the disparity of discard data in time, multiple regression was applied to obtain an effort (time spent at sea) raising by fleet and species. For SSBM priors have been set for the initial biomass (Yinit) in 1990 (long run) and 2009 (short run), the intrinsic growth rate (r), the carrying capacity (K), the process error (σ), the observation error (τ) and the catchability (q). Model outputs from SSBM and SPicT tends to follow the same biomass trajectories. Initial biomass in 1990 has been estimated to be under 0.5 of the biomass at MSY for all species. The biomass is increasing for all of them, even if these stock rebuilding dynamics are not going at the same speed for all species. The second is the use of Close-Kin Mark Recapture (CKMR)

method to estimate population size of thornback ray population in Subarea 8 (Bay of Biscay) and Subarea 4 and divisions 3.a and 7.d (Greater North Sea). CKMR is a new genetic technique, which allow establishing relationships among individuals in the absence of pedigree data and provides the basis for an estimation of the ray population by combining genomic kinship analysis with statistical modelling of population dynamics.

WGEF considers that there is scope in the future to move some of the category 3 skate and ray stocks into category 2 or 1. Further exploratory analysis will be undertaken and four stocks (por.27.nea, rjn.27.678abd, rjc.27.8 and rju.27.7de) will be benchmarked in 2022. In addition, WGEF made recommendations for a future benchmark of three North Sea ray in 2023.

For other species, WGEF followed the latest ICES guidelines on the assessment of data-limited stocks (ICES, 2012a).. In 2021, the group followed recommendations of WKSKATE which defined criteria for representativeness of surveys to be included in stock assessment, evaluated the suitability of different survey indicators and explored different methods of combining surveys (ICES, 2021). This implied that for some stocks (i.e. rjc.27.3a47d, sdv.27.nea and syc.27.3a47d) surveys were added to the assessment as these provide additional information on stock trends, while for spotted ray in Subarea 4 and divisions 3.a and 7.d (rjm.27.3a47d) the UK(E&W)–BTS–Q3 was excluded as it did not meet the agreed criteria for representativeness for this stock. For most species, survey data were available in DATRAS. However, some survey data, such as the BTS-BEL-Q3, are extracted by national institutes from their own national database because the full time series of the survey is not yet available in DATRAS. For certain low-abundance species, only landings information is available. For demersal elasmobranchs in the Celtic and North Sea, a 'survey status' is provided for each species. For Bay of Biscay and Iberia Coast, besides survey data for more frequently caught species, there is also fishery-dependent information. Survey data quickly illustrate the relative abundance of each species in each survey, as well as a visual indication of trends in abundance and mean length. Further details are outlined in each section.

1.15 InterCatch

In 2021, InterCatch was used to submit landings and discard data. InterCatch is solely used as a database to store official landings and discard data. Landings figures are supplied by individual members, after data formatting undertaken by WGEF (e.g. allocation to stock, quality assurance, reallocation of misidentified species). These corrected data are considered to be more accurate than official statistics as regional laboratories can better provide information on local fisheries and interpretation of nominal records of various species (including errors in species coding).

In 2021, landings data were requested in the InterCatch SI format and were requested to be submitted to InterCatch. However, not all nations have followed up on the data call and submitted the data to data.call@ices.dk. As such, part of the landings data were retrieved from the Accessions folder.

1.16 Transparent Assessment Framework (TAF)

TAF is a new framework, currently in development, to organize all ICES stock assessments. Using a standard sequence of R scripts, it makes the data, analysis, and results available online, and documents how the data were pre-processed. Among the key potential benefits of this structured and open approach are improved quality assurance and peer review of ICES stock assessments. Furthermore, a fully scripted TAF assessment is easy to update and rerun later with a new year of data. As of spring 2018, the first assessments are being scripted in standard TAF scripts (i.e. NE Atlantic spurdog (dgs.27.nea)). See http://taf.ices.dk for more information.

During the WGEF 2020 meeting, progress was made to have the processing of the InterCatch output being scripted in TAF. TAF includes the issues list and stock allocation file needed. The issues list will need to be updated on a yearly basis.

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